

Claims

1. An electric circuit breaker (1) for protecting an
5 electrical circuit (3) against excessive current loads,
comprising
- a switch (11) to be arranged in said electrical
circuit (3);
 - first means (13) for causing said switch (11) to
10 break said electrical circuit (3) in response to a
tripping signal (14);
 - means (17) for receiving (IF) and storing (MEM) a
programmable current threshold command (CC);
 - means (15) for detecting a current level (CL) in
15 said electrical circuit (3); and
 - processing means (16) for generating said tripping
signal (14) depending on said stored programmable
current threshold command (CC) and said detected current
level (CL).
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2. The electric circuit breaker (1) according to claim
1, wherein said means (15) for detecting a current level
in said electrical circuit comprises
- means (R) for converting an electrical current
25 flowing in said electrical circuit into a voltage; and
 - means (151) for detecting said voltage and
outputting a corresponding current level detection
signal (CL).
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3. The electric circuit breaker (1) according to claim
2, wherein said means (15) for converting an electrical

current into a voltage comprises a shunt impedance (R) or an arrangement of coils magnetically coupled to constitute a transformer or a hall effect device or a magnetoresistor or a Rogosky coil.

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4. The electric circuit breaker (1) according to any one of the preceding claims, wherein said processing means (16) is adapted to generate said tripping signal (14) after said detected current level (CL) has continuously
10 exceeded said programmed current threshold (I_3 , I_4 , I_5) for a specified duration T_j .

5. The electric circuit breaker (1) according to claim 4, wherein said specified duration can be programmed to
15 depend on the detected level of current (CL) in said electric circuit (3).

6. The electric circuit breaker according to claim 4 or 5, comprising means (17) for receiving and storing a
20 command which specifies said duration T_j .

7. The electric circuit breaker (1) according to claim 5 or 6, comprising

- means for storing a second current threshold (I_1)
25 higher than said programmed current threshold (I_3 , I_4 , I_5);
- said specified duration being a first duration, predetermined or programmed, if said detected current level (CL) is above said programmed current threshold
30 (I_3 , I_4 , I_5) and below said second current threshold (I_1),

and a second duration, predetermined or programmed, and shorter than said first duration if said detected current level (CL) is above said second current threshold (I_1).

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8. The electric circuit breaker (1) according to claim 7, comprising

- means to receive a second current threshold command;

10 - said second current threshold storing means being adapted to store said second current threshold in accordance with said received second current threshold command.

15 9. The electric circuit breaker (1) according to claim 7 or 8, wherein

- said programmable current threshold (I_3 , I_4 , I_5) is lower than said rated current level (I_1); and

20 - said second current threshold (I_1) is lower than the current level (I_2) corresponding to said force threshold.

10. The electric circuit breaker (1) according to claim 4,

25 wherein said processing means (16) is adapted to

- provide a plurality of functional relations (331, 332, 333) each specifying for a plurality of current levels (I) a respective associated duration (t); and

- select one of said functional relations (331, 332, 333) in accordance with said current threshold command (CC).

5 11. The electric circuit breaker (1) according to claim 10, wherein said functional relations are stored in said processing means (16) in the form of tables or in the form of software routines for calculating said functional relations.

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12. The electric circuit breaker (1) according to any one of the preceding claims, comprising means (17) for receiving a circuit close command; and means (13) for operating said switch (11) to close the electrical
15 circuit in response to said circuit close command.

13. The electric circuit breaker (1) according to any one of the preceding claims, comprising means (17) for receiving a circuit interrupt command; and means (13)
20 for operating said switch (11) to break said electrical circuit (3) in response to said circuit interrupt command.

14. The electric circuit breaker (1) according to any
25 one of the preceding claims, comprising power line communication means (171, IF) for receiving said commands via a public electric power line (LV, 2) which feeds said electric circuit (3) through said switch (11).

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15. The electric circuit breaker according to any one of the preceding claims, comprising

- second means (12) for causing said switch (11) to break said electrical circuit (3) if a current flowing
5 in said electrical circuit exceeds a predetermined rated current (I_R) for more than a specified duration (31, 32).

16. The electric circuit breaker (1) according to claim
10 15, said second means (12) comprising

- a thermal current level detection element; and
- means for causing said switch (11) to break said electrical circuit (3) if said thermal current level detection element exceeds a temperature threshold.

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17. The electric circuit breaker according to any one of the claim 15 or 16, said second means (12) comprising

- electromagnetic current level detection means including a coil; and
- 20 - means for causing said switch (11) to break said electrical circuit (3) if a magnetic force generated by said coil exceeds a threshold.

18. The electric circuit breaker (1) according to claim
25 15, said second means (12) comprising

- a thermal current level detection means for thermally detecting an amount of current (I) flowing in said electrical circuit;
- means for causing said switch to break said
30 electrical circuit (3) if said thermal current level detection means exceeds a temperature threshold

determining the rated current (I_1) of said electrical circuit breaker (1);

- electromagnetic current level detection means including a coil for generating a magnetic force in accordance with the amount of current (I) flowing in said electrical circuit (3); and

- means for causing said switch means to break said electrical circuit if said magnetic force generated by said coil exceeds a force threshold (I_2);

10 - said electromagnetic current detection means and said thermal current level detection means being dimensioned such that an electrical current level (I_2) corresponding to said force threshold is higher than said rated electrical current level (I_1).

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19. The electric circuit breaker (1) according to any one of the claims 15 to 18, wherein

- said switch (11) comprises a mechanical interruption element in series with a solid state interruption element;

20 - said second means (12) for causing said switch to break said electrical circuit if a current (I) flowing in said electrical circuit (3) exceeds a predetermined rated current (I_1) is arranged to trip said mechanical interruption element; and

25 - said first means (13) for causing said switch to break said electrical circuit in response to a tripping signal (14) is arranged to trip said solid state interruption element.

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20. The circuit breaker according to any one of the claims 15 to 19, wherein said first means (13), said second means (12) and said switch (11) are integrated into a single unit.

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21. The circuit breaker according to any one of the preceding claims, wherein

- said first means (13) comprises a coil (131) for electro magnetically driving a movable member (132) and
10 an auxiliary switch (133) connected in series with said coil (131);
- said switch (11) and said auxiliary switch (133) being mechanically coupled with said movable member (132) for actuation thereby;
- 15 - a displacement (θ 133) required for opening said auxiliary switch (133) being larger than a displacement (θ 11) required for opening said switch (11).

22. An electricity meter (100) for measuring the amount
20 of energy supplied to an electricity consumer (Hn) through an electric circuit (3), comprising an electric circuit breaker (1) according to any one of the preceding claims.

25 23. The electricity meter (100) according to claim 22, comprising

- means (18) for multiplying said detected current level (CL) with a supply voltage (U) of said electrical circuit (3) in order to obtain a measure for the
30 instantaneous active and reactive power levels supplied to said electric circuit (3); and

- means (18) for integrating said obtained instantaneous power levels over time in order to obtain the active and reactive energy supplied to said electrical circuit (3).

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24. An electricity distribution network, comprising

- at least one electrical power plant for generating electrical power to be distributed to a plurality of consumers (H1, H2, ..., Hn);
- 10 - an electrical power distribution network (HV, MV, LV) for distributing the power generated by said at least one power plant to said consumers (H1, H2, ..., Hn); and
- a plurality of electric circuit breakers (1)
- 15 according to any one of the claims 1 to 18 and/or a plurality of electricity meters (100) according to claim 21 or 22.

25. The electricity distribution network according to
20 claim 24, comprising administration and control facilities (21) for monitoring load conditions in said power distribution network (HV, MV, LV), and for generating at least one of said commands for said electric circuit breakers (1) in accordance with said
25 monitored load conditions.

26. The electricity distribution network according to claim 25, comprising

- a plurality of primary substations (Tp) arranged between high voltage portions (HV) and medium voltage portions (MV) of said electricity distribution network;
- a plurality of secondary substations (Ts) arranged
5 between medium voltage portions (MV) and low voltage portions (LV) of said electricity distribution network;
- communication means (CBT) arranged at at least one of said secondary substations for receiving commands from said administration and control facilities (21),
10 and for generating said current threshold commands (CC) and/or circuit close commands and/or circuit interrupt commands in accordance with commands received from said administration and control facilities (21);
- power line communication means (24) for injecting
15 said commands generated by said communication means (CBT) into a low voltage portion (LV, 2) of said electricity distribution network for transmission to at least one of said electricity consumers (H1, ..., Hn);
- said administration and control facilities (21) and
20 said communication means (CBT) being arranged to communicate with each other via a public telephone network (20).

27. The electricity distribution network according to
25 claim 26, wherein said public telephone network is a wireless mobile telephone network (20, 23).